Atty. Docket No. OPP-GZ-2007-0016-US-00
Application No: 10/722,295

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Remarks

Applicant and his representatives wish to thank Examiner Chen for the thorough examination of the present application and the detailed explanations in the Office Action dated January 25, 2007. The amendment to claim 1 corrects an inadvertent antecedent basis issue (a trench" was recited twice). New Claim 25 is Claim 1, but with the word "ends" has been replaced with --upper corners-- (with regard to the polish stop layer). The latter issue was discussed at length in the Office Action dated January 25, 2007. Thus, neither new matter nor new issues are believed to be introduced by the present amendment.

The Objection to the Amendment Filed November 3, 2006 under 35 U.S.C. § 132(a) and the Rejection of Claim 1 under 35 U.S.C. § 112, First Paragraph

The objection to the Amendment filed November 3, 2006 under 35 U.S.C. § 132(a) and the rejection of claim 1 under 35 U.S.C. § 112, first paragraph, as failing to comply with the written description requirement is respectfully traversed.

If the essence of the original disclosure supports a new claim limitation, the new limitation is not new matter. See *In re Wright*, 866 F.2d 422 (Fed. Cir. 1989). Claim 1 is clearly supported by the essence of the original disclosure which discusses rounding the upper corners of the silicon nitride layer 13 in order to enlarge the opening of the trench 100. Specifically, at page 4, paragraph [0013] it is noted that "etching is performed such that *ends* of the polish stop layer adjacent the trench are *rounded*." Additionally at page 8, paragraphs [0033] – [0035] it is noted that "areas of the silicon nitride layer 13 under the ends of the ARC 14 are *etched* such that the upper corners are *rounded*." Furthermore, it is clearly shown in FIGS. 2C and 2D that the ends of the polish stop layer are rounded *along substantially the entire thickness of the polish stop layer*. As a result, there is sufficient support for claim 1, and Applicant's undersigned representative respectfully requests that this ground of rejection be withdrawn.

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The Rejection of Claims 1-6 and 8-22 under 35 U.S.C. § 103(a)

The rejection under 35 U.S.C. § 103(a) of Claims 1-6 and 8-22 as being unpatentable over Moore et al. (US 6,884,725) in view of Bamnolker et al. (US 6,890,859) is respectfully traversed.

Moore et al. discloses a method of forming a trench in a semiconductor device, where the method includes forming a nitride layer 16 or etch-stop layer 16a on a substrate 12, as shown in FIG. 1, etching the through the etch-stop layer 16a and into the substrate 12 to form an opening 20, as shown in FIGS. 2-4, growing a first oxide fill layer 24 within the opening 20, as shown in FIG. 5, and *then* subjecting the nitride-containing etch-stop layer 16a to a *facet etch* to reduce the sharpness of the corners. Therefore, Moore uses a first etch to go through the etch-stop layer 16a and into the substrate 12 and a *second facet etch* to form a facet on the etch-stop layer 16a.

Furthermore, Moore also fails to disclose etching the semiconductor substrate to form a trench that has *sloped* sidewalls, as recited in Claim 1. Moore et al. discloses that each opening 20 in substrate 12 shown in FIGS. 3-5, 10-11 and 13-14 of Moore et al. has *straight* sidewalls. Moore et al. does not affirmatively disclose any openings 20 in substrate 12 that have *sloped* sidewalls, as recited in Claim 1, either in the Figures or in the specification. While it has been asserted that the trench inherently has some *surface roughness* that provides sloped sidewalls, Applicant's undersigned representative respectfully requests that the basis for this assertion be supported by a publication. Applicant maintains that certain etch process are designed to form a trench having sloped sidewalls, while others (e.g., pure anisotropic etching) are designed to minimize, if not eliminate, any sloping of the sidewalls.

Inherency, however, may not be established by *probabilities* or *possibilities*. The mere fact that a certain thing may result from a given set of circumstances is not sufficient. *In re Oelrich*, 666 F.2d 578, 581 212 USPQ 323, 326 (CCPA 1981). As demonstrated by the FIGS. in Moore et al. itself (which clearly show straight sidewalls), and when there is no indication in the specification of Moore et al. that a trench having sloped sidewalls is even desirable, an assertion that the trench formed in Moore et al. has sloped sidewalls appears to be based on possibility, rather than certainty.

When a reference is silent about the asserted inherent characteristic, as Moore et al. is about sloped sidewalls, such gap in the reference may be filled with recourse to extrinsic evidence. Such evidence must make clear that the missing descriptive matter is necessarily present in the thing described in the reference, and that it would be so recognized by persons of ordinary skill. *EMI Group N. Am., Inc. v. Cypress Semiconductor Corp.*, 268 F.3d 1342; 60 USPQ2d 1423 (Fed. Cir. 2001), quoting *Continental Can Co. v. Monsanto Co.*, 948 F.2d 1264, 1268; 20 USPQ2d 1746, 1749 (Fed. Cir. 1991). Moore et al. appears to establish the ***opposite*** – their trenches have straight sidewalls. Thus, Moore et al. does not and cannot establish certainty regarding the shape or slope of the sidewalls in their trenches.

Additionally, Moore et al. fails to teach or disclose etching the polish stop layer and the semiconductor substrate such that ends of the polish stop layer adjacent to the trench are *rounded along substantially the entire thickness* of the polish stop layer, as recited in Claim 1. Etching the polish stop layer such that ends of the polish stop layer are rounded along substantially the entire thickness of the polish stop layer enables filling a relatively narrow trench in the substrate with an insulation layer using previous-generation trench filling equipment in commercially acceptable yields. (See paragraph 6 of the Declaration under 37 CFR 1.132 of Young-Hun Seo dated October 30, 2006.) More specifically, based on knowledge of actual production data for manufacturing processes having a critical dimension of 0.18 μm or less, etching the polish stop layer such that ends of the polish stop layer are rounded along substantially the entire thickness of the polish stop layer enables filling a trench in the substrate with an insulation layer using trench-filling equipment designed for manufacturing processes having a critical dimension of more than 0.18 μm (e.g., 0.25 μm) in commercially acceptable yields. (See paragraph 11 of the Declaration under 37 CFR 1.132 of Young-Hun Seo dated October 30, 2006.)

The difference in trench-filling capability between the presently claimed method and an otherwise comparable process in which ends of the polish stop layer are not significantly rounded is unexpected. In other words, prior to the present invention, one of ordinary skill in the art(s) of semiconductor processing and/or manufacturing would not have predicted that etching the polish stop layer such that ends of the polish stop layer are rounded along substantially the

entire thickness of the polish stop layer would enable filling a trench in the substrate using a manufacturing process having a critical dimension of 0.18 μm with an insulation layer using trench-filling equipment designed for manufacturing processes having a critical dimension of more than 0.18 μm (e.g., 0.25 μm) in commercially acceptable yields. (See paragraph 13 of the Declaration under 37 CFR 1.132 of Young-Hun Seo dated October 30, 2006.) In addition, the benefit of using the same trench-filling equipment for both types of manufacturing processes (i.e., having a critical dimension of 0.18 μm or less, and having a critical dimension of, e.g., 0.25 μm) is commercially significant, in terms of reducing the cost of wafers manufactured on processes having a critical dimension of 0.18 μm or less, maximizing the investment in trench-filling equipment for manufacturing processes having a critical dimension of more than 0.18 μm (e.g., 0.25 μm), and maximizing efficiency of floor space in a fab configured for manufacturing wafers using both types of manufacturing processes. (See paragraph 10 of the Declaration under 37 CFR 1.132 of Young-Hun Seo dated October 30, 2006.)

While FIG. 11 in Moore forms rounded corners 60, the rounded corners 60 are not *along substantially the entire thickness* of the polish stop layer (see, e.g., FIGS. 2C and 2D of the present application). The benefits and improvements provided by the present invention are not suggested by Moore et al., alone or in combination with Bamnolker et al. As a result, Moore et al. is saliently deficient with regard to Claim 1.

Bamnolker et al. fail to cure all of the deficiencies of Moore et al.

Bamnolker et al. disclose a method for forming a trench in a semiconductor substrate, which has a silicon layer, an oxide layer overlying the silicon layer, and a nitride layer overlying the oxide layer (Abstract, ll. 1-4). The method includes etching the nitride layer to a nitride end point using a nitride etching chemistry, which includes a fluorinated hydrocarbon, oxygen, and an inert gas selected from the group consisting of neon, argon, krypton, xenon, and combinations thereof (Abstract, ll. 4-8). However, neither nitride layer 8 (col. 1, ll. 21-40 and FIGS. 1-3) or nitride layer 30 (col. 3, ll. 60-67; col. 4, ll. 26-40; and FIG. 6) appear to have ends that are rounded along substantially the entire thickness of the layer. Thus, Bamnolker et al. fail to cure

all of the deficiencies of Moore et al. with regard to the present Claim 1, including the benefits and unexpected improvements provided by the presently claimed method.

Consequently, this ground of rejection is unsustainable, and should be withdrawn.

Conclusions

In view of the above amendments and remarks, all bases for objection and rejection are overcome, and the application is in condition for allowance. Early notice to that effect is earnestly requested.

If it is deemed helpful or beneficial to the efficient prosecution of the present application, the Examiner is invited to contact Applicant's undersigned representative by telephone.

Respectfully submitted,

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